marine sciences paper 15
geological survey of canada paper 75-42

gravity and magnetic fields of the Gulf of St. Lawrence, Canada

by Richard T. Haworth and J. Brian MacIntyre
geological survey of canada

A joint publication of the

Canadian Hydrographic Service
Department of the Environment
and the
Geological Survey of Canada
Department of Energy, Mines and Resources
Ottawa, Canada

1977

Published by

Environment Canada

Fisheries and Marine Service

Office of the Editor
116 Lisgar, Ottawa K1A 0H3

Publié par

Environnement Canada

Service des pêches et des sciences de la mer

Bureau du Rédacteur
116 Lisgar, Ottawa K1A 0H3

marine sciences paper 15
geological survey of canada paper 75-42

gravity and magnetic fields of the Gulf of St. Lawrence, Canada

by Richard T. Haworth and J. Brian MacIntyre
geological survey of canada

A joint publication of the

Canadian Hydrographic Service
Department of the Environment
and the
Geological Survey of Canada
Department of Energy, Mines and Resources
Ottawa, Canada

1977

Available by mail from En vente par la poste

Printing and Publishing
Supply and Services Canada
Ottawa, Canada K1A 0S9

Imprimerie et Édition
Approvisionnements et Services Canada
Ottawa, Canada K1A 0S9

or through your bookseller ou chez votre libraire

or from ou au

Hydrographic Chart Distribution Office
Department of the Environment
P.O. Box 8080, 1675 Russell Rd.
Ottawa, Canada K1G 3H6

Bureau de distribution des cartes marines
Ministère de l'Environnement
Boîte postale 8080, 1675, chemin Russell
Ottawa, Canada K1G 3H6

Catalog No. En 36–504/15
ISBN 0-660-00686-3

Canada: $3.00
Other countries: $3.60

Canada: $3.00
Autres pays: $3.60

N° de catalogue En 36–504/15
ISBN 0-660-00686-3

Price subject to change without notice *Prix sujet à changement sans avis préalable*

Ottawa 1977 *Ottawa 1977*

THORN PRESS LTD.
CONTRACT NO. 09KT. KF802-6-0493

This report is issued as a joint publication of the Department of the Environment and the Department of Energy, Mines, and Resources in order to serve a wider public. It may be cited:

— Haworth, R. T., and J. B. MacIntyre. 1977.
Gravity and magnetic fields of the Gulf of St. Lawrence, Canada. Marine Sciences Paper 15. 11 p.
(*Also* Geological Survey of Canada Paper 75-42)

CONTENTS

ABSTRACT 1

RÉSUMÉ 1

INTRODUCTION 2

DATA SOURCES AND COMPILATION TECHNIQUES 2

1) Detailed Survey Data from BIO 3

Data collection and compilation 5

2) Published Contour Maps of Data from Other Institutions 5

Geological Survey of Canada 5

Earth Physics Branch 6

U.S. Geological Survey 7

Imperial Oil Enterprises Limited 7

3) Sparse BIO and Other Data 7

INTERPRETATION 7

REFERENCES 10

FIGURES

1. Sources of gravity data 2

2. Sources of magnetic field data 3

3. Ship's tracks 4

4. Physiographic elements of the Gulf of St. Lawrence 4

5. Comparison of hand- and machine- contoured maps 5

6. Geological elements of the Gulf of St. Lawrence and adjacent areas 8

7. Grenville Orogen 10

MAPS
(in pocket)

811-D. Gulf of St. Lawrence: gravity (Bouguer anomaly) (1:1 000 000)

811-E. Gulf of St. Lawrence: magnetic anomaly (1:1 000 000)

GRAVITY AND MAGNETIC FIELDS OF THE GULF OF ST. LAWRENCE, CANADA

BY R. T. HAWORTH AND J. B. MACINTYRE

Atlantic Geoscience Centre, Geological Survey of Canada
Bedford Institute of Oceanography, Dartmouth, N.S. B2Y 4A2

ABSTRACT

Gravity and magnetic field data collected along approximately 55 000 km of closely spaced ship's tracks in the Gulf of St. Lawrence, Canada, have been compiled at a scale of 1:1 000 000 and set against a background of data collected on a more regional scale.

The Canadian Shield is characterized by low Bouguer gravity anomalies and short wavelength magnetic anomalies. Localized gravity lows within the shield are produced by granites and anorthosites, whereas highs are produced by gabbros. A sinuous band in which there are high gradients in the gravity and magnetic fields shows a regional correlation with the boundary between the Canadian Shield and the Appalachian Orogen, and is interpreted as indicating the eastern limit of the early Paleozoic continental crust. Within the Appalachian Orogen the gravity and magnetic anomalies are predominantly lineated southwest–northeast, indicating the trend of faults initiated parallel to the Paleozoic margin during the final stages of continental collision.

RÉSUMÉ

Des données sur le champ de la pesanteur et le champ magnétique recueillies le long d'environ 55 000 km de routes maritimes très rapprochées dans le golfe du Saint-Laurent, au Canada, ont été compilées sur une carte à l'échelle de 1:1 000 000 et confrontées à des données recueillies à une échelle plus régionale.

Le bouclier canadien se caractérise par de faibles anomalies de Bouguer et par des anomalies magnétiques locales de courte longueur d'onde. Les zones locales de faible gravité y sont dues aux granites et aux anorthosites, celles de forte gravité, aux gabbros. Une bande sinueuse, où on observe des gradients élevés dans le champ de la pesanteur et le champ magnétique, fait voir une relation à l'échelle régionale avec la limite entre le bouclier canadien et la région orogénique des Appalaches et est interprétée comme une indication de la limite orientale de l'écorce terrestre au début de la période paléozoïque. La direction prédominante des anomalies de la pesanteur et des anomalies magnétiques dans la région orogénique des Appalaches est du sud-ouest–nord-est, indiquant l'orientation des failles produites parallèlement à la marge continentale du paléozoïque durant les derniers stades de la collision continentale.

INTRODUCTION

The Canadian Hydrographic Service and the Atlantic Geoscience Centre have been cooperating in routine geophysical surveys of the Atlantic seaboard of Canada since 1964 (Melanson and Ewing 1970; Macnab 1973). The recent compilation of all the data collected by those surveys has produced a set of detailed 1:250 000 gravity and magnetic maps published in the Natural Resource Series (Canadian Hydrographic Service 1974). In order to interpret specific anomalies defined by those maps, a regional description of the gravity and magnetic fields is necessary. The maps at a scale of 1:1 000 000 accompanying this report attempt to fulfill that requirement for the Gulf of St. Lawrence by placing the detailed data against a background of both published and unpublished data.

For convenience, the maps have been made compatible in area, scale, and projection with a marine geomorphic map of the Gulf of St. Lawrence (Canadian Hydrographic Service 1973) with which a surficial sediment map (Loring and Nota 1973) is also compatible. Further editions covering other parameters are anticipated in the same series. Although this report concerns only the Gulf of St. Lawrence, the data from which the maps were prepared were collected over a much larger area. Bouguer gravity and magnetic anomaly maps of the Grand Banks, Scotian Shelf, and much of the Gulf of St. Lawrence, compiled on the same projection and at the same scale, can be found in Haworth and MacIntyre (1975).

Details of data collection, compilation, and processing have been omitted where they are identical with those in Haworth and MacIntyre (1975). Minor but significant changes have been made in the program used to prepare a grid of average data in areas of sparse data coverage. The coverage of the Gulf of St. Lawrence in this report includes more data than were available during the preparation of Haworth and MacIntyre (1975). Although no attempt was made in the earlier report to reconcile apparent differences between data sets at survey boundaries, in this compilation we did try to do so. Details of the problems involved are included in this report so that users of the maps may recognize their limitations.

DATA SOURCES AND COMPILATION TECHNIQUES

There are two main data sources: the published and unpublished data of the Bedford Institute of Oceanography (BIO), and the published data of other institutions. These data are treated under three headings:

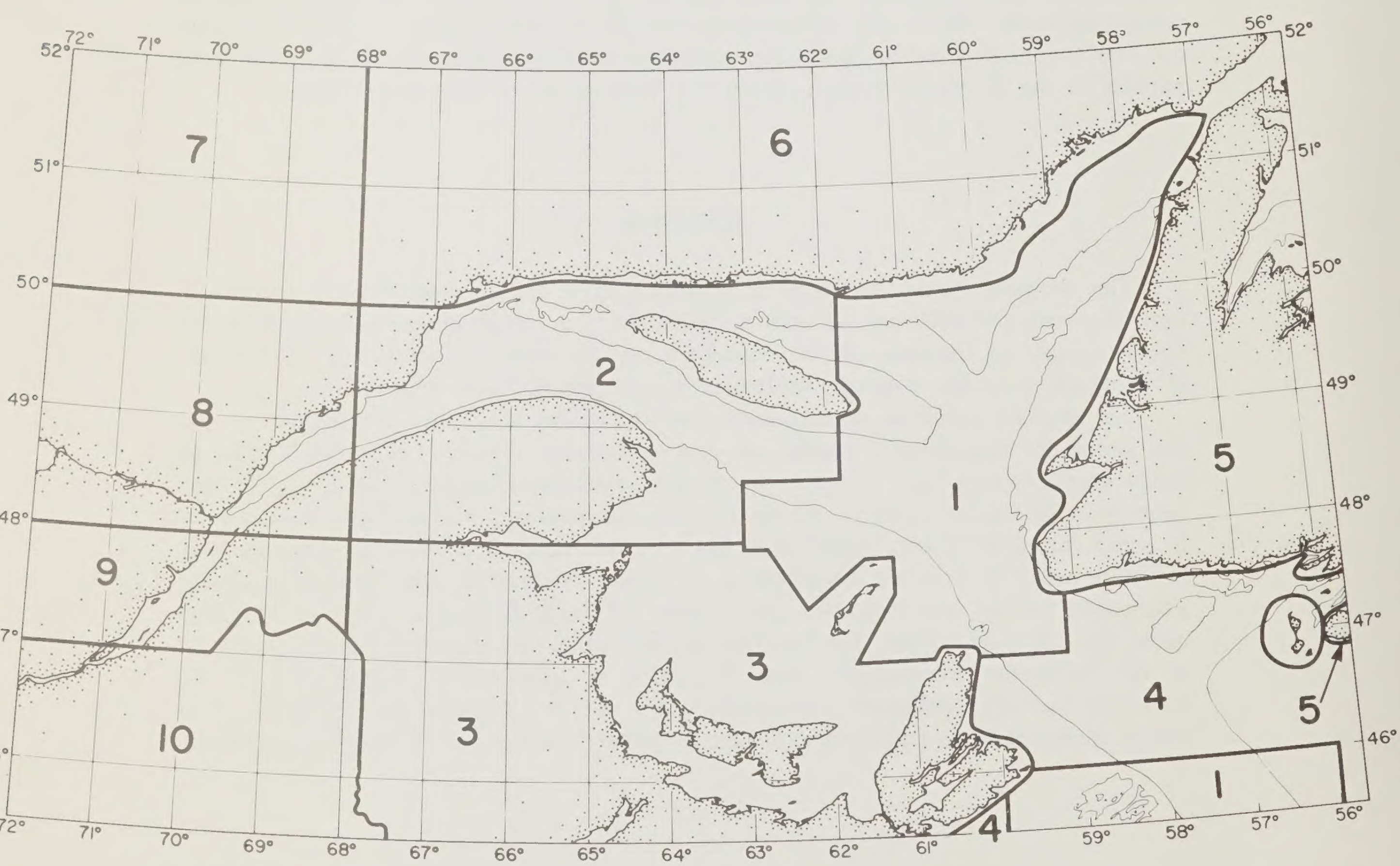


FIG. 1. Sources of gravity data. 1, Atlantic Geoscience Centre (AGC) data from which 1:250 000 Natural Resource Series maps were produced; 2, Earth Physics Branch (EPB) data, Goodacre et al. 1969; 3, Stephens and Cooper 1973; 4, AGC and EPB data averaged over 25 km grid; 5, Weaver 1968; 6, Thomas 1976; 7, EPB Gravity Map 22-68; 8, EPB Gravity Map 78-69; 9, Thompson and Garland 1957; and 10, Kane et al. 1972.

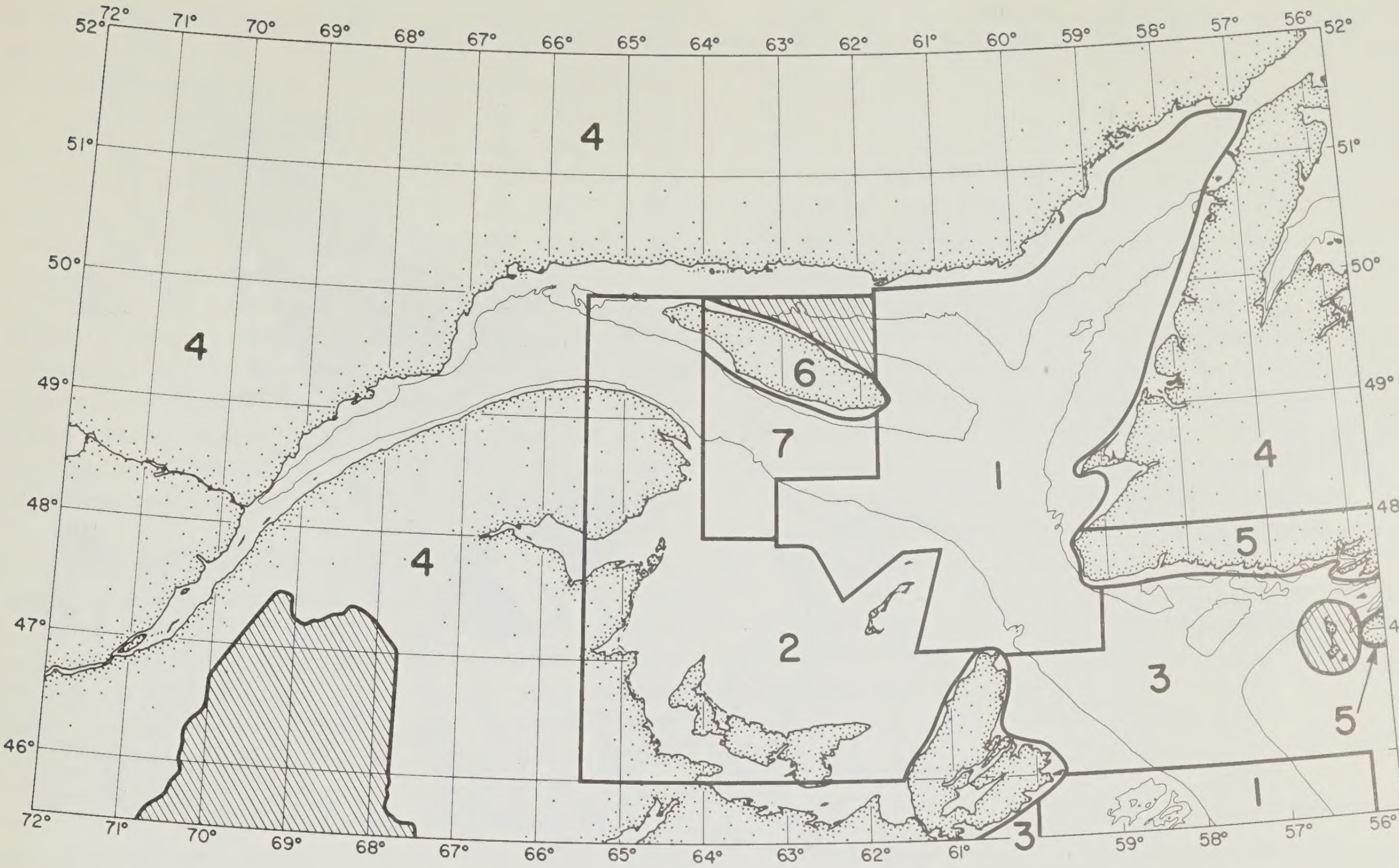


FIG. 2. Sources of magnetic field data. 1, Atlantic Geoscience Centre (AGC) data from which 1:250 000 Natural Resource Series maps were produced; 2, Hood et al. 1975; 3, AGC data averaged over 25 km grid; 4, Morley et al. 1971 (values increased by 200 nT, see text); 5, Source 2, regionalized to be compatible with Source 4; 6, Imperial Oil Ltd. data, see Roliff 1968; and 7, AGC data, hand-contoured to provide continuity with contiguous areas.

1) *Detailed Survey Data from BIO* compiled in the form of Natural Resource Series maps have been copied directly to this compilation.

2) *Published Contour Maps of Data from Other Institutions* which do not overlap the detailed BIO data have been copied directly to this compilation.

3) *Sparse BIO and Other Data* have been combined where possible and averaged to provide a regional definition of the potential fields.

In practice the divisions are not quite so definite, but the complexities will become apparent as each category is dealt with. The distribution of source material is shown in Fig. 1 and 2.

1) Detailed Survey Data from BIO

During the summers of 1968 and 1969, the Canadian Hydrographic Service (CHS) conducted detailed surveys in the eastern portion of the Gulf of St. Lawrence with the geophysical support of what is now a component of the Atlantic Geoscience Centre. The lines covered during those surveys (cruise *Baffin* 68-021, DeGrasse 1968; cruise *Baffin* 69-021, DeGrasse 1969) and the few additional tracks that were run en route to other survey areas are shown in Fig. 3. The general physiographic division of the St. Lawrence River and the Gulf of St. Lawrence and the names by which features will be referred to are shown in Fig. 4.

In general the spacing of the survey lines is that defined by hydrographic survey instructions, which require that line spacing be reduced in shallower water to increase the probability of locating hazards to navigation. There is however an inshore limit to the survey for the safety of the survey vessel. In this case the survey was carried out by the CSS *Baffin* (4700 Mg, 87 m long, 6 m draft), and so the inshore limiting depth was set at approximately 30 m in the southern portion of the survey area. For the northern area, the depth limit was set at approximately 100 m due to the abrupt changes in bathymetry along the north shore of the Gulf of St. Lawrence and the existence of inshore surveys from the 1930s in the vicinity of the Mecatina Trough and the inner shelf of the Quebec north shore and Labrador. Survey lines were run at 0.9-, 1.8-, 3.7-, or 7.4-km spacing (½, 1, 2, or 4 nautical miles), the more closely spaced lines being run over the shallow shelf areas. Thus the northeastern part of the Magdalen Shelf was surveyed at 0.9-km line spacing, as were portions of the Newfoundland shelf near Port au Port Peninsula and the outer shelf southeast of the Mecatina Trough. The majority of the 1968 survey

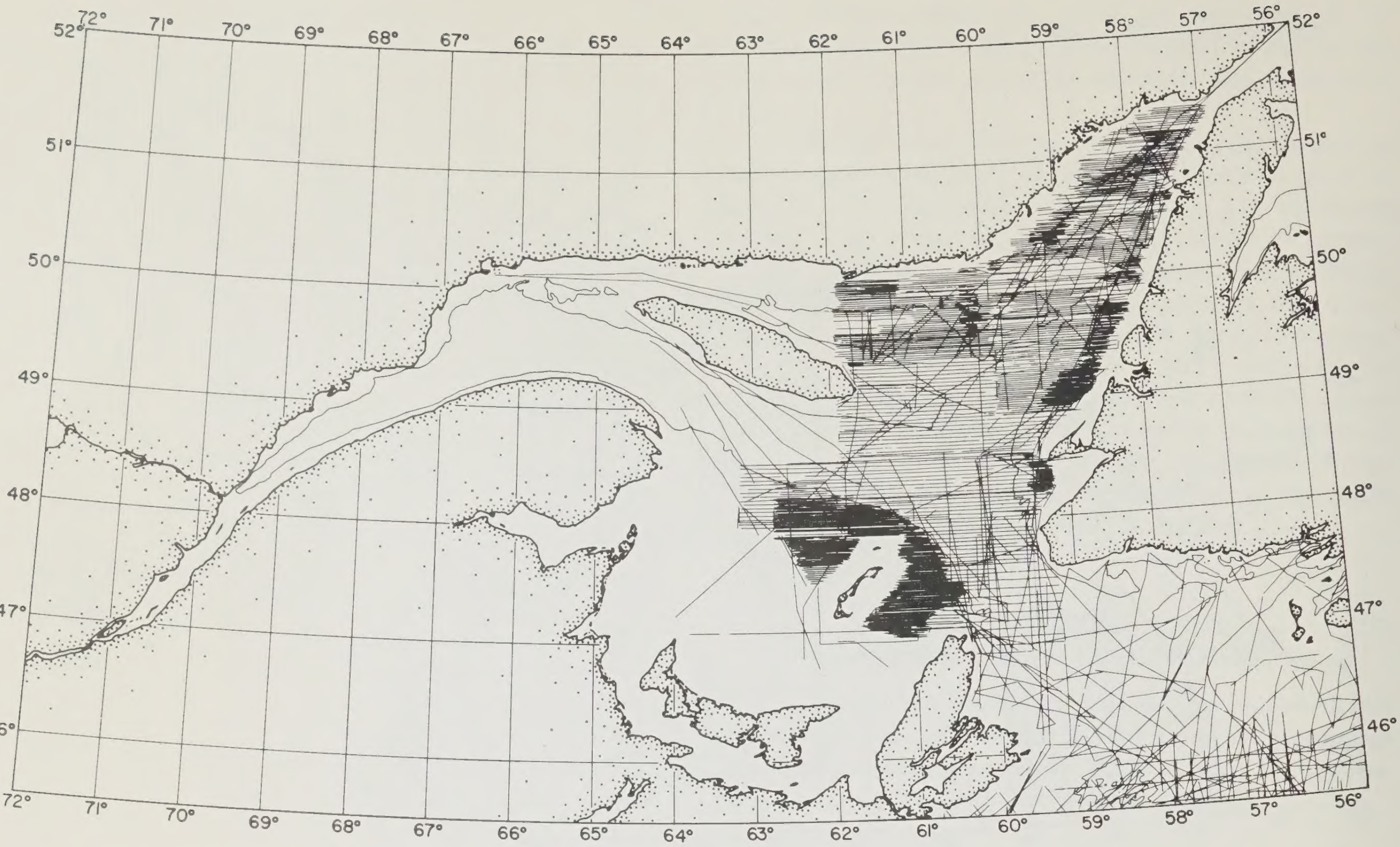


FIG. 3. Bedford Institute of Oceanography ship's tracks along which the gravity and magnetic field data used in this compilation were collected.

FIG. 4. Physiographic elements of the Gulf of St. Lawrence, and locations referred to in the text.

in the northeastern gulf was carried out with a 1.8-km line spacing whereas the southern portion, except for the Magdalen Shelf areas, has a predominant line spacing of 3.7 km. In the southeastern part of the area, in the vicinity of Cabot Strait, the line spacing was 7.4 km because the Canadian Hydrographic Service had already collected necessary bathymetry data and such a line spacing was considered sufficient to extend regional geophysical coverage through the strait.

Isolated lines north of Anticosti Island (cruise *Baffin* 68-021), south of Anticosti Island (cruise *Baffin* 73-014 and *Baffin* 74-015), through Cabot Strait (cruise *Baffin* 68-018), and from the northwestern tip of Prince Edward Island (cruise *Hudson* 65-024) are also included in the compilation. Southeast of Cabot Strait a series of lines were collected during cruises *Dawson* 72-009 and *Hudson* 73-006.

Data collection and compilation — Throughout the areas covered by the detailed surveys, gravity data were collected using a Graf-Askania Gss-2 sea surface gravimeter mounted on an Anschutz gyro-stabilized platform. Details of the data recording and processing methods have been described by Haworth and Loncarevic (1974). Total magnetic field data were collected with a proton precession magnetometer towed approximately 200 m astern of the vessel. Diurnal and storm variations of the magnetic field were recorded at Dartmouth and at monitor stations operated intermittently around the Gulf of St. Lawrence (Srivastava 1971). Following preliminary data editing, the digital gravity and magnetic data were processed under contract to produce 1:250 000 Natural Resource maps (Haworth 1974; Canadian Hydrographic Service 1974). Free air gravity anomaly maps for the Gulf of St. Lawrence were not included in the contract (as they were for other areas covered) because hand-contoured maps had already been published. However, the published maps were compared with machine-contoured products using the final data file (Fig. 5) and good agreement was found. This indicates that, although the gravity data file for this area was not so rigorously checked because there was no requirement for producing large-scale maps from it, the data file appears to be accurate. Machine-contoured 1:1 000 000 maps covering the areas of detailed surveys were produced from the data file and form the basis for the overall compilation. They were copied almost in their entirety directly to the master compilation sheets.

Outside the areas for which Natural Resource maps were produced (Fig. 1 and 2), the BIO data were collected on more widely spaced lines and were compiled as discussed in Section (3).

2) Published Contour Maps of Data from Other Institutions

Geological Survey of Canada (Resource Geophysics and Geochemistry Division) — The Geological Survey of Canada has an extensive program of aeromagnetic surveys

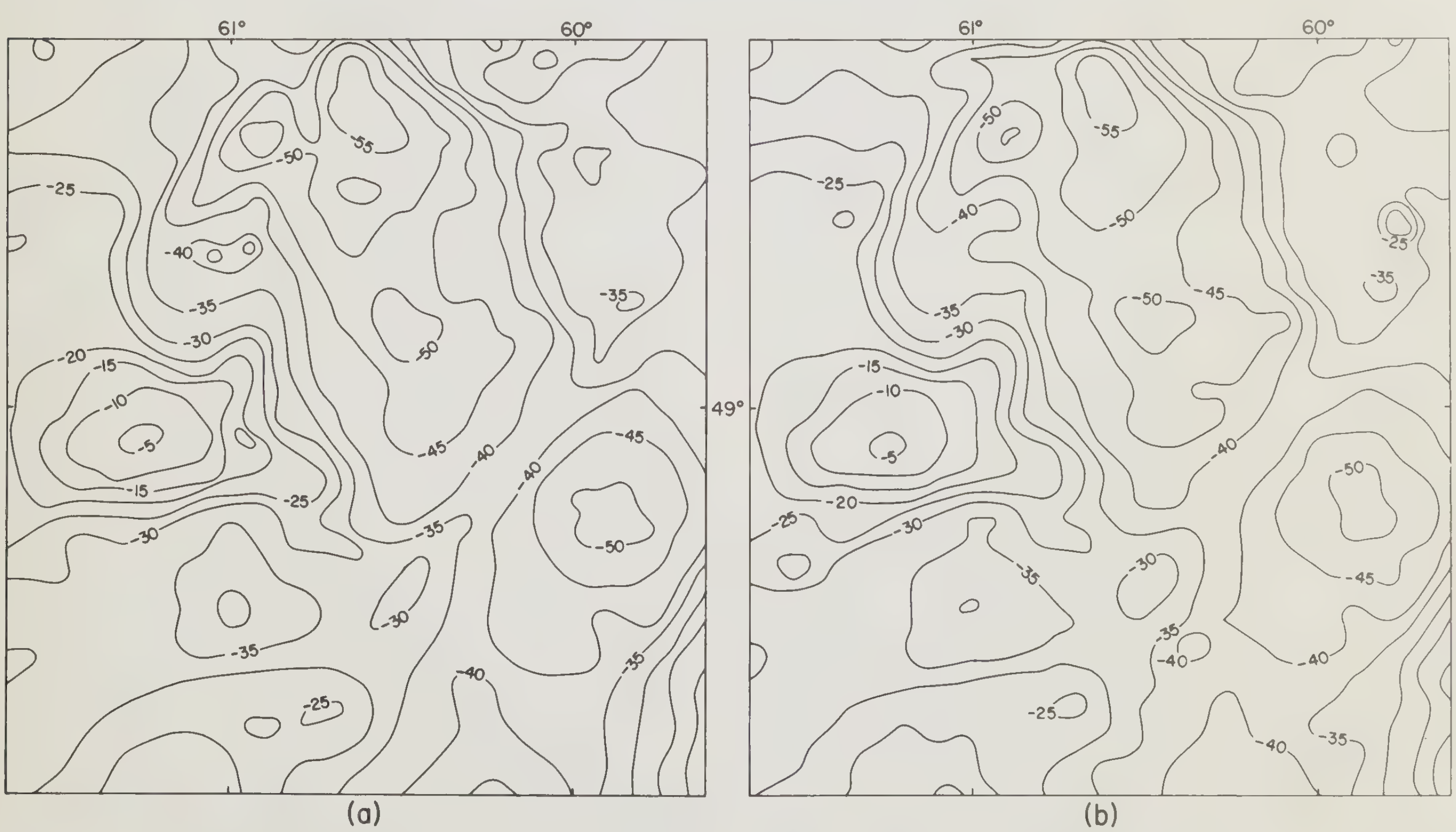


Fig. 5. Comparison of (*a*) hand- and (*b*) machine-contoured maps of a portion of the Gulf of St. Lawrence indicating that the data file from which the machine-contoured maps were produced was almost entirely error free.

in eastern Canada (McGrath et al. 1973). The basic means of publication of the aeromagnetic data is as maps of the total magnetic field at a scale of 1:63 360 with an overlay of flight lines to indicate control. In addition the aeromagnetic data have been compiled in the form of magnetic anomalies and presented at a scale of 1:5 000 000 (Morley et al. 1971). That map depicts anomalies having a diameter greater than 10 km, with respect to a reference field which is a modified version of the map of the total field (F) for 1965.0 (Dawson and Dalgetty 1966). A new magnetic map (Hood et al. 1975) is being prepared at a scale of 1:1 000 000, and a copy of a partially completed Maritime Provinces map was kindly made available by Dr. Peter Hood. This shows anomalies with respect to IGRF for the area of this map south of 50°N and east of 68°W. This means that although it is compatible with the marine data described earlier in this report, considerable areas of land are covered only by the older, and more regional, map (Morley et al. 1971). Since the primary requirement for the compilation presented here is to show the data over the marine area, the contributing compilations were used so as to preserve as much detail as possible over the marine area, keeping the land coverage as consistent as possible (Fig. 2). The only difficulty was the exclusion of Newfoundland south of 48°N by Morley et al., from whose map magnetic contours were derived for the remainder of the island. Contours from the new aeromagnetic IGRF map were therefore generalized to provide coverage in the south consistent with that throughout the remainder of the island.

A disruption in the contour levels exists at the junctions between data sets because Morley et al. (1971) contoured at intervals of 200 nT, the aeromagnetic IGRF map has 100-nT contours and the marine data were contoured at 50-nT intervals. In order to subdue this difference, a color interval of 200 nT was used for this compilation.

As a consequence of the difference between the reference fields to which the various surveys have been referred, there is some difference between the absolute values of the same anomaly portrayed on different maps. The maximum difference between the levels of the marine magnetic map and the aeromagnetic IGRF map used in the compilation is 50 nT, but the trends shown by the two data sets are in excellent agreement. Unfortunately, some distortion exists in the map of Morley et al. (1971). Anomalies that were observed during BIO surveys close to the north shore of the Gulf of St. Lawrence are not, in some cases, shown in their correct position on this small-scale map, presumably because of progressive distortion during its compilation and printing. Although positioning errors of up to 20 km can be seen in the vicinity of the Quebec north shore, it is almost impossible to eliminate the distortion.

An experimental unified map for a portion of the northern gulf has been prepared (Haworth et al. 1976) by matching apparently common features covered by two or more surveys and deducing the geographical shifts in position and difference in datum levels. The geographical shifts were variable and therefore could only be made adjacent to the boundaries between surveys. The datum shifts, however, were consistent, an indication that they could be applied overall. The difference between the aeromagnetic IGRF data and the marine magnetic IGRF data alternated about zero with a scatter of less than 50 nT so that the two sets of contours could be artistically merged. The IGRF data, however, are generally 200 nT higher than those of Morley et al. (1971). Once that datum shift was made, the contours could be merged. Since the potential field data presented for the land areas are intended to show regional aspects only, rather than to be used as a prime data source, the same approach was used in the magnetic anomaly compilation presented here. If users wish to investigate localized correlations of the magnetic field with other parameters in the areas covered by the Geological Survey of Canada surveys, they should refer to the basic 1:63 360 total magnetic field maps from which the anomaly maps were created. When the basic aeromagnetic data are available in digital form, or the new 1:1 000 000 compilation of land data is complete, it should be possible to integrate the data so as to provide better continuity between the survey areas. In the meantime, the reader may choose between the merged presentation of this compilation, the segregated presentation of map 801-E (Haworth and MacIntyre 1975), the basic 1:250 000 Natural Resource Series maps, or the 1:63 360 aeromagnetic maps, depending on the purpose he has in viewing the data.

Earth Physics Branch (Gravity Division) — The Gravity Division of the Earth Physics Branch (formerly the Dominion Observatory) is engaged in the regional gravity mapping of Canada. Generally, the data collected are compiled and published in the Gravity Map Series, each map usually accompanied by a report. Longer interpretative texts are also available for some areas. Maps of Newfoundland (Weaver 1968), Quebec (Thompson and Garland 1957), the Gulf of St. Lawrence (Goodacre et al. 1969), and the Scotian Shelf (Stephens and Cooper 1973) were used in the compilation of regional gravity data as a background to the marine data. These data were collected with a wide variety of instruments, particulars of the equipment and station spacing being given in each survey report.

Except for the area east of Cape Breton Island and south of Newfoundland, the contours from maps of the Earth Physics gravity surveys have been transferred directly to the compilation presented here to provide the regional gravity field as background for the BIO survey data.

Gravity data for the area southeast of Cabot Strait were used in combination with the BIO data and presented in the form used for the sparsely covered areas as described in Section (3). That form was chosen so that the detail would be compatible in the gravity and mag-

netic maps presented in this report. Although this means a loss in definition in this presentation of some of the gravity anomalies on the Scotian Shelf, that detail may be found in the original Earth Physics Branch data (Stephens and Cooper 1973).

For a uniform definition of the gravity field over most of the compilation area incorporating all the Earth Physics Branch and BIO data by use of a computer gridding technique, although sacrificing the detail of the marine data, the reader is referred to the Gravity Map of Canada (1974).

U.S. Geological Survey (USGS) — The southwest portion of the compilation area includes part of Maine. Since the United States Geological Survey has published a gravity compilation map including that area (Kane et al. 1972), the available data have been included in this compilation. The original sources of the data used in the map are quoted by Kane et al. (1972) as Kane and Bromery (1966) and Fitzpatrick (1959). A compatible source of magnetic field data was not found.

Imperial Oil Enterprises Limited — Aeromagnetic data have been collected over Anticosti Island by Imperial Oil and an interpretation has been published (Roliff 1968). A large-scale map of the original data was made available by Imperial Oil. The data had been referenced to an arbitrary base and an unspecified regional gradient had been removed. However, a bulk correction to the data provided agreement with the Geological Survey of Canada aeromagnetic data to the west and the marine magnetic data to the east, indicating that the regional gradient was the same as that of IGRF. The adjusted data were therefore transferred directly to the compilation presented here, merged with the other magnetic data.

3) Sparse BIO and Other Data

The area southeast of Cabot Strait is less systematically surveyed, so that the geophysical data tend to be unevenly distributed. The sea surface gravity data are augmented by bottom gravity measurements made on a relatively regular grid by Earth Physics Branch, but no such supplementary magnetic data are available. Since the data coverage could not uniformly resolve gravity or magnetic features with a wavelength of less than $\frac{1}{4}°$ (approximately 28 km) a $\frac{1}{4}°$ grid spacing was selected as the basis for machine contouring.

The machine-contouring method used is as described by Haworth and MacIntyre (1975) except for one basic point. The program originally employed to produce a grid of data (GRIDIT/CRUDEGRID, Richardson 1969) assigned each mean data value to the center of the appropriate grid cell. This effectively offsets the data where the data lines are unevenly distributed within a grid cell. This effect is overcome in the modified gridding program by assigning the mean data value to the mean geographic position of the contributing data points with each grid cell. The output grid thus produced was then input to the California Computer Products Inc. package GPCP (Calcomp 1971) as randomly distributed data, which were then contoured in a single computer run.

The output of the computer gridding and contouring process can represent only the strong regional trends of the area. No feature of the magnetic or gravity fields represented with a wavelength of less than twice the gridding interval, approximately 50 km, can be given much credence. This is particularly true for the magnetic field contours based on only the widely spaced BIO lines. Some additional help is given to the gravity map by the Earth Physics 13-km grid of underwater data. In using the regional field defined in the areas of sparse data coverage, reference should be made to Fig. 3 to obtain some idea of the existing control.

For the area south of Anticosti Island, this process was used to define the regional change in the magnetic field on the basis of five isolated lines linking areas of more detailed marine magnetic or aeromagnetic coverage (Fig. 3). With the assistance of that map, the original data were then hand contoured to provide continuity with the data in adjacent areas.

Since only magnetic data were available on these lines, the underwater gravity data (Goodacre et al. 1969) have been used on their own in the gravity compilation.

The lines north of Anticosti Island were run during 1968 but because of their isolation in an area of short wavelength magnetic anomalies, they cannot provide even a definition of the regional magnetic field, hence the void in the magnetic anomaly map.

INTERPRETATION

The object of this paper is to present all the gravity and magnetic field data collected in the Gulf of St. Lawrence at a scale convenient for the interpretation of localized anomalies within the context of regional variations, defined primarily on the adjacent land areas. Interpretations of geophysical data in the southern gulf (Watts 1972) and the northern gulf (Haworth et al. 1976) have been used in regional syntheses (Haworth 1975 a, b) with a more thorough discussion of the potential field variations. A résumé of that work is presented here.

The general regional character of the gravity and magnetic fields reflects the divisions between the principal geological elements of the region (Fig. 6). The Canadian Shield is associated with low Bouguer gravity anomalies and short wavelength magnetic anomalies, whereas the Appalachian Orogen is characterized by higher Bouguer gravity anomalies and generally longer wavelength magnetic anomalies. The two regions are separated by a sinuous zone along which a relatively continuous gradient exists in both the gravity and magnetic fields. Those gradients are enhanced or diminished depending on the local bedrock exposures. Each of these zones will be examined briefly.

Bouguer gravity anomalies over the Canadian Shield are generally less than −30 mgal. An analysis of the

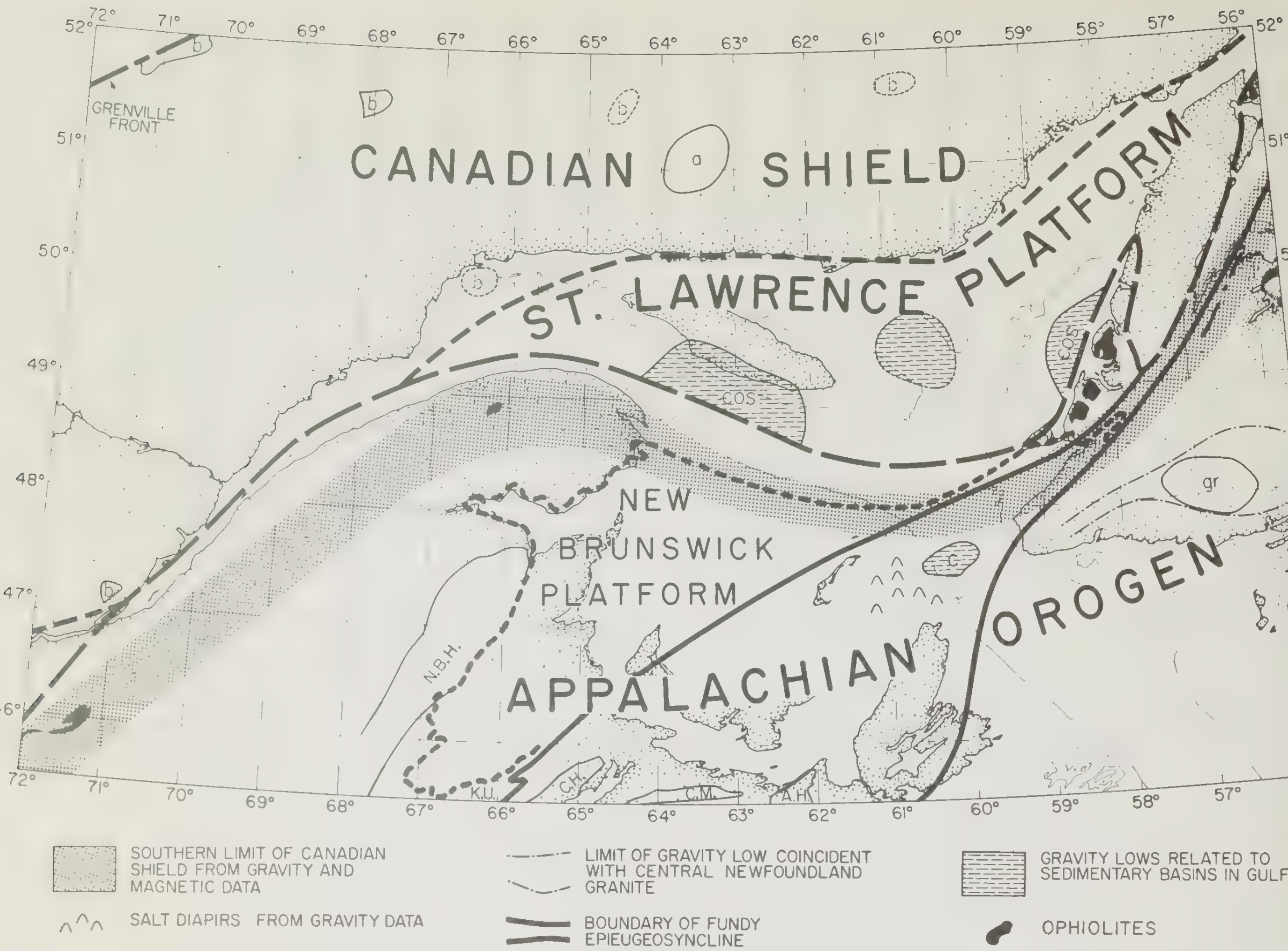


FIG. 6. Geological elements of the Gulf of St. Lawrence and adjacent areas (Poole et al. 1970) referred to in the discussion of the principal features of the gravity and magnetic field. A.H., Antigonish Highlands; C.M., Cobequid Mountains; C.H., Caledonia Highlands; K.U., Kingston Uplift; N.B.H., New Brunswick Highlands; a, anorthosite; b, gabbro; gr, granite.

correlation between gravity variations and geology in Quebec north of the Gulf of St. Lawrence led Thomas (1976) to conclude that the localized gravity highs are attributable to gabbroic masses and the lows to granite and anorthosite. The gabbros at 51°30′N, 68°W; 51°30′N, 64°30′W; and 51°30′N, 61°W and the anorthosite at 51°N, 63°30′W are bodies specifically considered by Thomas. The lowest Bouguer anomalies of the map-area considered here occur at its northwestern corner. These low values correlate with the position of the Grenville Front and are interpreted as being caused by an increase in crustal thickness and by lateral density variations within the upper part of the crust (Mereu and Jobidon 1971). The general area of the Grenville Front gravity low correlates with an area in which the magnetic anomalies have a relatively long wavelength. The only significant anomalies close to the Grenville Front are associated with gabbros such as that at 51°30′N, 68°W and the more localized body at 51°30′N, 71°W.

The Bouguer anomalies rise and the magnetic anomalies increase to the southeast, culminating in a set of alternating positive and negative bands of magnetic and gravity anomalies close to the St. Lawrence estuary. A band of relatively high Bouguer anomalies, running along the north shore of the St. Lawrence estuary, does not correlate well with the geology, although locally gabbros coincide with the higher gravity values. The highest gravity anomaly within the band just south of Sept Iles coincides with a large magnetic anomaly. Thomas (1976) interprets this gravity anomaly as caused by a gabbroic body 11 km thick.

A band of low Bouguer anomalies lies southeast of the band of gravity highs, roughly along the southern shore of the St. Lawrence estuary. The steepest part of the gravity gradient between the two linear trends coincides with a positive magnetic anomaly along the axis of the St. Lawrence estuary. Farther to the southeast is another band of high gravity anomalies of which the highest values are in the vicinity of Thetford Mines and the Chic-Choc mountains of Gaspé. These local gravity highs coincide with magnetic highs. A recent geological synthesis of the Quebec Appalachians (St. Julien and Hubert 1975) indicates that these anomalies are associated with the ophiolites exposed as a result of thrusting during the

Taconian (Ordovician) orogeny. Similar gravity and magnetic anomalies are also found in Newfoundland over the ophiolites near Bay of Islands (Williams 1973), Hare Bay (Williams et al. 1973; Williams and Smyth 1974), and east of White Bay (Dewey and Bird 1971).

There are close similarities between the changes in gravity occurring along a line running southwest from the Quebec north shore across Anticosti Island to Gaspé, and the changes occurring along a line southeastward from the Quebec north shore, passing east of Banc Beaugé into Bay of Islands. Low gravity values over the Quebec north shore are succeeded by higher values over Anticosti Trough and Esquiman Trough. This increase in gravity has been interpreted in terms of an increase in density of the basement rocks close to the southern limit of Precambrian basement beneath the Paleozoic cover (Haworth et al. 1976). Close to the southwestern edge of Anticosti Island and offshore from Bay of Islands, the Bouguer anomalies decrease coincident with an increase in thickness of the Paleozoic sedimentary rocks overlying the Precambrian basement (Roliff 1968; Hobson and Overton 1973). In the center of the Laurentian Trough southwest of Anticosti Island, and also close to the coast in the vicinity of Bay of Islands, the gravity anomalies rise abruptly. Model studies indicate that the source of at least part of this change in gravity anomalies occurs at depth (Haworth et al. 1976). A similar conclusion was reached in analysis of the gravity data over New England (Diment 1968), part of the zone throughout the eastern United States where steep gravity gradients correlate with the zone of Appalachian thrusting (Woollard and Joesting 1964; Zietz et al. 1966). Although the gravity gradient within the Gulf of St. Lawrence is not as distinct as it is off Gaspé or in western Newfoundland, the broad positive anomalies centered at 48°N, 61°30′W and in the Port au Port Peninsula probably mark the southern crest of the gradient within the gulf. The differences in crustal section across a line roughly coincident with the line of maximum gravity gradient (Ewing et al. 1966; Weaver 1968; Rankin et al. 1969), the presence of ophiolites on the south side of the line of gradient, and the marked differences in stratigraphy and structure (Williams et al. 1972) across a boundary which on a large scale parallels the line of gravity gradient, all contribute to the interpretation that the gravity gradient marks the southern limit of the continental crust that underlaid eastern Canada in early Paleozoic time and that was subsequently deformed during the Taconian and Acadian orogenies that resulted from continental collision (Bird and Dewey 1970; Haworth 1975b).

The only significant interruption of the gravity gradient in the gulf occurs southwest of Port au Port Peninsula. A northward trending zone of negative Bouguer anomalies joins a prominent gravity low southwest of Banc Beaugé with a more intense low east of Iles de la Madeleine. The anomaly near Banc Beaugé may be interpreted as being caused by an anorthosite body or by an increase in thickness of the lower Paleozoic cover rocks (Haworth et al. 1976). The proximity of similar anomalies over the southwest coast of Anticosti Island and offshore from Bay of Islands, where an increase in the thickness of Paleozoic cover is substantiated, perhaps favors the sedimentary basin interpretation for the Banc Beaugé anomaly. The Iles de la Madeleine gravity low is also interpreted in terms of a basin, but contains relatively low density Carboniferous sedimentary rocks (Goodacre et al. 1969). This interpretation is supported by seismic reflection and refraction data (Hobson and Overton 1973). The many short wavelength gravity lows on the western side of the main gravity anomaly are due to salt diapirs within the Carboniferous sequence (Watts 1972; Watts and Haworth 1974).

The Carboniferous structures with which the Madeleine gravity lows are associated lie south of the gravity gradient dividing line, within the Appalachian Orogen, where the potential field trends are generally lineated southwest–northeast. In New Brunswick and offshore, the pre-Carboniferous basement is fractured by a series of northeast-trending normal faults (Howie and Cumming 1963; Bhattacharyya and Raychaudhuri 1967). The elevated blocks such as the Kingston Uplift and the Caledonia Highlands are delineated by magnetic and gravity anomalies that enable their extensions to be traced beneath the Carboniferous cover of southeastern New Brunswick. These northeasterly trends are all terminated against the pronounced gravity and magnetic gradients associated with the northern edge of the Appalachian Orogen.

Within Newfoundland the trends are also predominantly southwest–northeast and extend across the Cabot Strait into Cape Breton. This set of anomalies marks the latest Devonian–early Carboniferous faults bounding the northern part of the Fundy epieugeosyncline (Belt 1968; Kelley 1970) in which the Carboniferous sediment was deposited. In southern Newfoundland, the extensive gravity low is created by a large body of Devonian granite that extends beyond its surface contact with the Ordovician–Silurian sedimentary rocks (Weaver 1967). That gravity anomaly narrows to the west, indicating the narrowing of the Central Mobile Belt of Newfoundland (Williams et al. 1970).

The general features of the potential field in the Gulf of St. Lawrence have been interpreted as resulting from collision between a North American and a Eurafrican continent in early to mid-Paleozoic time (Haworth 1975b). The projection of the Precambrian basement beneath western Newfoundland but not beneath central New Brunswick indicates that a salient exists at the edge of the Canadian Shield. If the Ordovician–Silurian sediments of central Newfoundland and New Brunswick were deposited in a closing ocean (Bird and Dewey 1970; Schenk 1971), then as the ocean closed, these sediments would be flexed around the edge of the salient. The structural lineations of New Brunswick (within the oceanic sed-

iments) are parallel to the colliding margin as the result of compression, and terminate against the edge of the salient (Fig. 7). Since the salient, in its forward position, will be subject to greatest compression during continental collision, its density is likely to increase, thereby raising the gravity field of the northeastern gulf and increasing the density contrast between the Paleozoic sedimentary rocks and basement. A lateral component of velocity between the two margins will induce faulting parallel to the margins during the late stages of collision, these faults being the locus for development of the Fundy epieugeosyncline (Haworth 1975b).

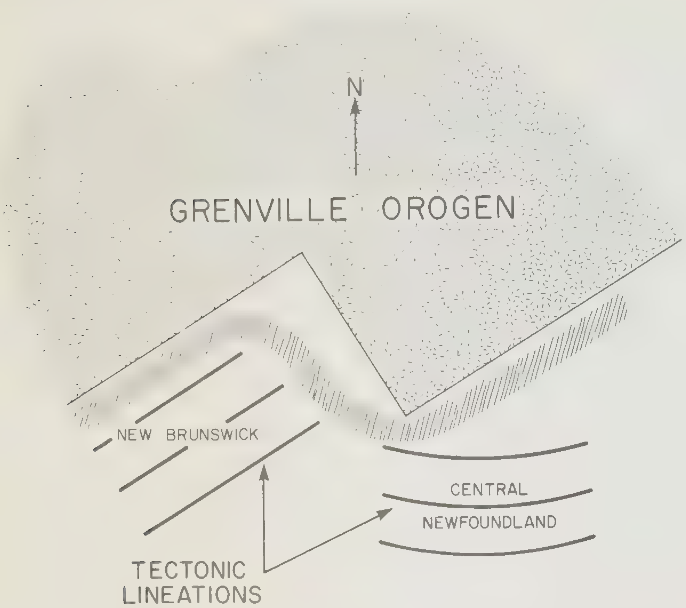


FIG. 7. A salient at the edge of the Canadian Shield (Grenville Orogen) is suggested by seismic refraction and magnetic field data. The potential field expression of pre-Carboniferous trends within New Brunswick are truncated against the band of gravity and magnetic gradients indicating the subsurface limit of the Grenville Orogen. In Newfoundland the pre-Carboniferous trends are warped around its edge.

REFERENCES

BELT, E. S. 1968. Newfoundland Carboniferous stratigraphy and its relation to the Maritimes and Ireland, p. 734–753. *In* M. Kay [ed.] North Atlantic — geology and continental drift. Am. Assoc. Pet. Geol. Mem. 12.

BHATTACHARYYA, B. K., AND B. RAYCHAUDHURI. 1967. Aeromagnetic and geological interpretation of a section of the Appalachian belt in Canada. Can. J. Earth Sci. 4: 1015–1037.

BIRD, J. M., AND J. F. DEWEY. 1970. Lithosphere plate–continental margin tectonics and the evolution of the Appalachian orogen. Geol. Soc. Am. Bull. 81: 1031–1060.

CALCOMP. 1971. GPCP — a general purpose contouring program. California Computer Products Ltd., Anaheim, Calif. 92801.

CANADIAN HYDROGRAPHIC SERVICE. 1973. Gulf of St. Lawrence. Bathymetric Chart 811, scale 1:1 000 000. Lambert conformal projection.

1974. Natural Resource Series Maps of bathymetry, free air gravity, and magnetic total field. Hydrogr. Chart Distrib. Off., Mar. Sci. Dir., Dep. Environ., Ottawa K1A 0E6.

DAWSON, E., AND L. C. DALGETTY. 1966. Magnetic charts of Canada for epoch 1965.0. Publ. Dom. Obs. Ottawa 31: 379–405.

DEGRASSE, F. L. 1968. Cruise report 224 (cruise 68-021, CSS *Baffin*). Bedford Inst. Oceanography, Dartmouth, N.S. (Unpublished)

1969. Cruise report 69-021 CSS *Baffin*. Bedford Inst. Oceanography, Darthmouth, N.S. (Unpublished)

DEWEY, J. F., AND J. M. BIRD. 1971. Origin and emplacement of the ophiolite suite: Appalachian ophiolites in Newfoundland. J. Geophys. Res. 76: 3179–3206.

DIMENT, W. H. 1968. Gravity anomalies in northwestern New England, p. 399–413. In E-an Zen [ed.] Studies of Appalachian geology — northern and maritime. Interscience Publishers, Inc., New York, N.Y.

EWING, G. N., A. M. DAINTY, J. E. BLANCHARD, AND M. J. KEEN. 1966. Seismic studies on the eastern seaboard of Canada: the Appalachian system, 1. Can. J. Earth Sci. 3: 89–109.

FITZPATRICK, M. M. 1959. Gravity in the eastern townships of Quebec. Ph.D. Dissertation. Harvard Univ., Cambridge, Mass. 135 p.

GOODACRE, A. K., B. G. BRULÉ, AND R. V. COOPER. 1969. Results of regional underwater gravity surveys in the Gulf of St. Lawrence. Dom. Obs. (Ottawa) Gravity Map Ser. No. 86.

GRAVITY MAP OF CANADA. 1974. Bouguer gravity anomaly map of Canada. Map GMS 74-1, 1:5 000 000. Can. Map Off., Dep. Energy, Mines, Resour., Ottawa K1A 0E9.

HAWORTH, R. T. 1974. Gravity and magnetic natural resource maps (1972), offshore eastern Canada — philosophy and technique in preparation by computer. Int. Hydrogr. Rev. 51: 131–155. (*Also* Mar. Sci. Pap. 13 and Geol. Surv. Can. Pap. 74-22)

1975a. Paleozoic continental collision in the northern Appalachians in light of gravity and magnetic data in the Gulf of St. Lawrence, p. 1–11. *In* W. J. M. van der Linden and J. A. Wade [ed.] Geology of offshore eastern Canada. Vol. 2. Geol. Surv. Can. Pap. 74-30.

1975b. The development of Atlantic Canada as a result of continental collision — evidence from offshore gravity and magnetic data, p. 59–77. *In* C. J. Yorath, E. R. Parker, and D. J. Glass [ed.] Canada's continental margins and offshore petroleum exploration. Can. Soc. Petrol. Geol. Mem. 4.

HAWORTH, R. T., AND B. D. LONCAREVIC. 1974. Inverse filter applied to the output of an Askania Gss-2 sea gravimeter. Geophysics 39: 852–861.

HAWORTH, R. T., AND J. B. MACINTYRE. 1975. The gravity and magnetic fields of Atlantic offshore Canada. Mar. Sci. Pap. 16: 22 p. (*Also* Geol. Surv. Can. Pap. 75-9)

HAWORTH, R. T., J. B. MACINTYRE, AND R. A. FOLINSBEE. 1976. Interpretation of geophysical data in the northern Gulf of St. Lawrence and its relevance to Lower Paleozoic geology. (Unpublished)

HOBSON, G. D., AND A. OVERTON. 1973. Sedimentary refraction seismic surveys, Gulf of St. Lawrence, p. 325–336. *In* P. J. Hood [ed.] Earth Science Symp. on Offshore Eastern Canada. Geol. Surv. Can. Pap. 71-23.

HOOD, P. J., P. H. MCGRATH, AND R. T. HAWORTH. 1975. Magnetic anomaly map of the Atlantic Provinces, p. 891. *In* C. J. Yorath, E. R. Parker, and D. J. Glass [ed.] Canada's continental margins and offshore petroleum

exploration. Can. Soc. Pet. Geol. Mem. 4. (Abstract only)

Howie, R. D., and L. M. Cumming. 1963. Basement features of the Canadian Appalachians. Geol. Surv. Can. Bull. 89: 18 p.

Kane, M. F., and R. W. Bromery. 1966. Simple Bouguer gravity map of Maine. U.S. Geol. Surv. Geophys. Invest. Map GP-580.

Kane, M. F., G. Simmons, W. H. Diment, M. M. Fitzpatrick, W. B. Joyner, and R. W. Bromery. 1972. Bouguer gravity and generalized geologic map of New England and adjoining areas. U.S. Geol. Surv. Map GP-839: 6 p.

Kelley, D. G. 1970. Geology of southeastern Canada — Carboniferous and Permian, p. 284–296. *In* R. J. W. Douglas [ed.] Geology and economic minerals of Canada. 5th ed. Geol. Surv. Can., Econ. Geol. Rep. 1.

Loring, D. H., and D. J. G. Nota. 1973. Morphology and sediments of the Gulf of St. Lawrence. Bull. Fish. Res. Board Can. 182: 147 p.

Macnab, R. F. 1973. The offshore surveys program: review and forecast. Proc. Canadian Hydrographic Service Conf., Victoria, B.C., 1973.

McGrath, P. H., P. J. Hood, and G. W. Cameron. 1973. Magnetic surveys of the Gulf of St. Lawrence and the Scotian Shelf, p. 339–358. *In* P. J. Hood [ed.] Earth Science Symp. on Offshore Eastern Canada. Geol. Surv. Can. Pap. 71-23.

Melanson, R. C., and G. N. Ewing. 1970. Multidiscipline surveys conducted by the Canadian Hydrographic Service, Atlantic Oceanographic Laboratory, Bedford Institute, Dartmouth, N.S., p. 11/1– p. 11–21. *In* Integrated surveying and mapping. Proc. 63rd Annu. Meet. Can. Inst. Surv., April 14–18, 1970.

Mereu, R. F., and G. Jobidon. 1971. A seismic investigation of the crust and moho on a line perpendicular to the Grenville Front. Can. J. Earth Sci. 8: 1553–1583.

Morley, L. W., A. S. MacLaren, and B. W. Charbonneau. 1971. Carte des anomalies magnétiques du Canada. Geol. Surv. Can. Map 1255. 2nd ed. 1:5 000 000.

Poole, W. H., B. V. Sanford, H. Williams, and D. G. Kelley. 1970. Geology of southeastern Canada, p. 228–304. *In* R. J. W. Douglas [ed.] Geology and economic minerals of Canada. 5th ed. Geol. Surv. Can., Econ. Geol. Rep. 1.

Rankin, D. S., R. Ravindra, and D. Zwicker. 1969. Preliminary interpretation of the first refraction arrivals in Gaspé from shots in Labrador and Quebec. Can. J. Earth Sci. 6: 771–775.

Richardson, A. 1969. Programmes used to study lineations in magnetic anomaly map of mid-Atlantic Ridge between 45°N and 46°N. Bedford Inst. Comput. Note 69-1-C. (Unpublished report)

Roliff, W. A. 1968. Oil and gas exploration — Anticosti Island, Quebec. Geol. Assoc. Can. Proc. 19: 31–36.

St. Julien, P., and C. Hubert. 1975. Evolution of the Taconian Orogen in the Quebec Appalachians. Am. J. Sci. 275A: 337–362.

Schenk, P. E. 1971. Southeastern Atlantic Canada, northwestern Africa and continental drift. Can. J. Earth Sci. 8: 1218–1251.

Srivastava, S. P. 1971. Diurnal variation of the total magnetic field along the east coast of Canada. Earth Planet. Sci. Lett. 10: 423–429.

Stephens, L. E., and R. V. Cooper. 1973. Results of underwater gravity surveys over the southern Nova Scotia continental shelf. Earth Phys. Branch Gravity Map. Ser. No. 149: 10 p.

Thomas, M. D. 1976. The correlation of gravity and geology in southeastern Quebec and southern Labrador. Earth Phys. Branch Gravity Map Ser. No. 64–67, 96–98.

Thompson, L. G. D., and G. D. Garland. 1957. Gravity measurements in Quebec (south of latitude 52°N). Publ. Dom. Obs. Ottawa 19: 111–132.

Watts, A. B. 1972. Geophysical investigations east of the Magdalen Islands, southern Gulf of St. Lawrence. Can. J. Earth Sci. 9: 1504–1528.

Watts, A. B., and R. T. Haworth. 1974. Geological interpretation of Bouguer anomaly and magnetic anomaly maps east of the Magdalen Islands, southern Gulf of St. Lawrence. Mar. Sci. Pap. 10: 9 p. (*Also* Geol. Surv. Can. Pap. 74-55)

Weaver, D. F. 1967. A geological interpretation of the Bouguer anomaly field of Newfoundland. Publ. Dom. Obs. Ottawa 35: 223–251.

1968. Preliminary results of the gravity survey of the island of Newfoundland. Dom. Obs. (Ottawa) Gravity Map Ser. No. 53–57.

Williams, H. 1973. Bay of Islands map-area, Newfoundland. Geol. Surv. Can. Pap. 72-34: 7 p.

Williams, H., M. J. Kennedy, and E. R. W. Neale. 1970. The Hermitage Flexure, the Cabot Fault, and the disappearance of the Central Mobile Belt. Geol. Soc. Am. Bull. 81: 1563–1568.

1972. The Appalachian structural province, p. 181–261. *In* R. A. Price and R. J. W. Douglas [ed.] Variations in tectonic styles in Canada. Geol. Assoc. Can. Spec. Publ. 11.

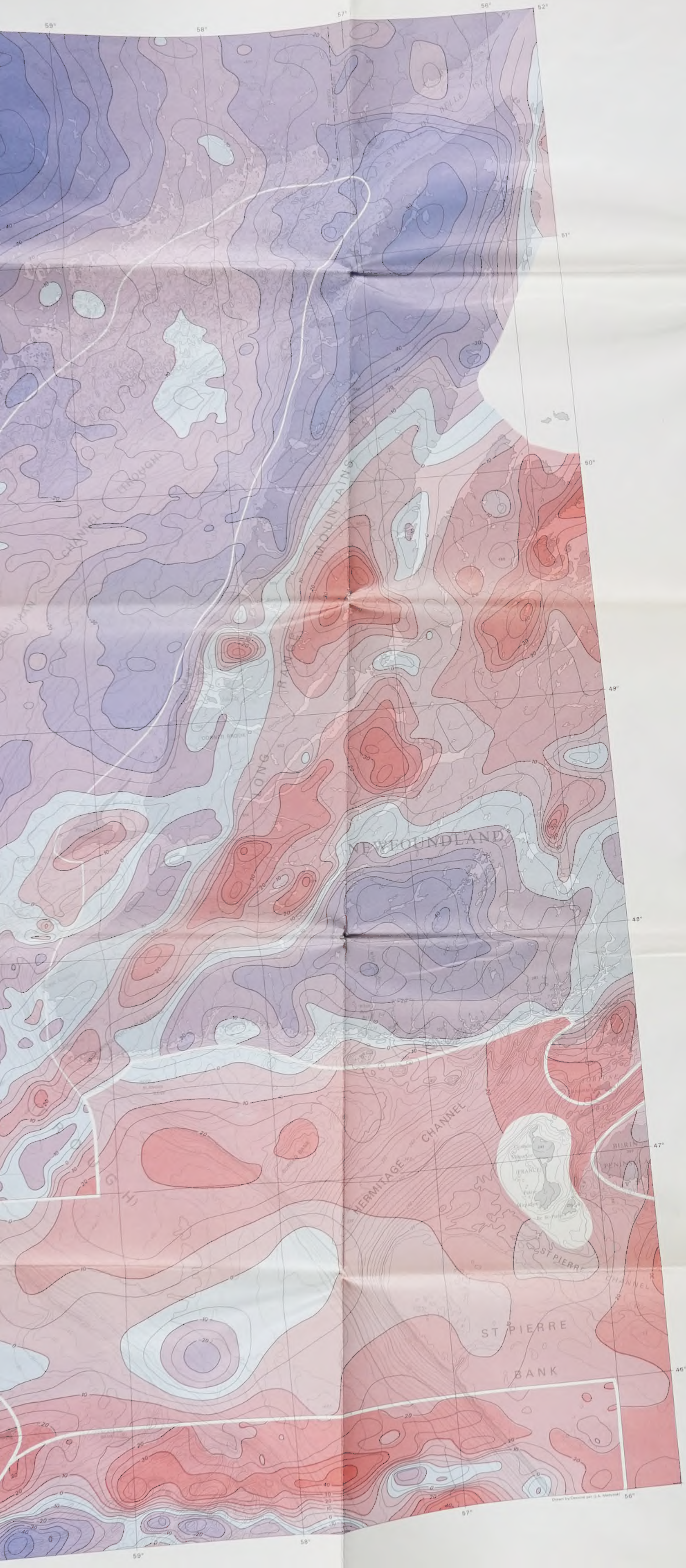
Williams, H., and W. R. Smyth. 1974. The Hare Bay allochthon, northern Newfoundland. Geol. Surv. Can. Pap. 74-1A: 3–6.

Williams, H., W. R. Smyth. and R. K. Stevens. 1973. Hare Bay allochthon, northern Newfoundland. Geol. Surv. Can. Pap. 73-1A: 8–14.

Wollard, G. P., and H. R. Joesting. 1964. Bouguer gravity anomaly map of the United States. Joint publication by Amer. Geophys. Union and U.S. Geol. Surv. (Map G64121)

Zietz, I., E.R. King, W. Geddes, and E. G. Lidiak. 1966. Crustal study of a continental strip from the Atlantic Ocean to the Rocky Mountains. Geol. Soc. Am. Bull. 77: 1427–1448.

811-D



GULF OF ST. LAWRENCE / GOLFE SAINT-LAURENT

GRAVITY (BOUGUER ANOMALY)

GRAVITÉ (ANOMALIE DE BOUGUER)

Compiled by R.T. Haworth, Atlantic Geoscience Centre
Cartography by the Canadian Hydrographic Service

Compilé par R.T. Haworth, Centre géoscientifique de l'Atlantique
Cartographie du Service hydrographique du Canada

GRAVITY CONTOURS IN MILLIGALS
(Referred to the International Gravity formula of 1930)

COURBES GRAVIMÉTRIQUES EN MILLIGALS
(D'apès la formule de gravité internationale de 1930)

BATHYMETRIC CONTOURS IN METRES

COURBES BATHYMÉTRIQUES EN MÈTRES

Lambert Conformal Projection (Standard Parallels 43N and 49N)

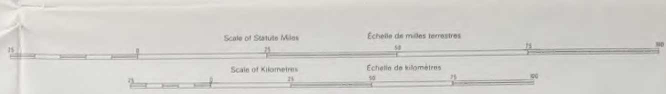
Projection conforme de Lambert (Parallèles standard 43N et 49N)

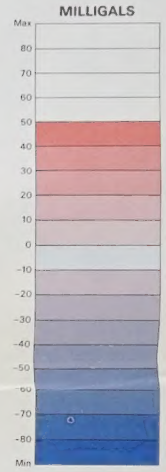
Scale 1:1 000 000

Échelle 1:1 000 000

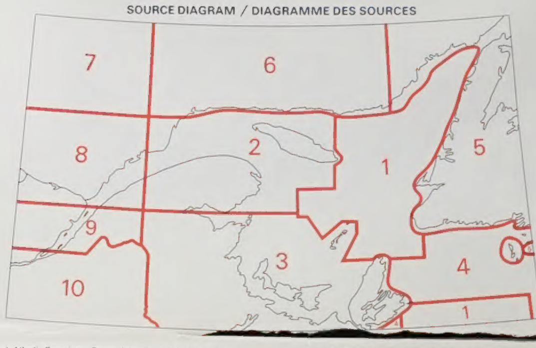
This map accompanies Marine Science Paper 15 / Geological Survey of Canada Paper 75-42, "The Gravity and Magnetic Fields of the Gulf of St. Lawrence", by R.T. Haworth and J.B. MacIntyre.

Cette carte est comprise dans l'étude 15 des Sciences de la Mer / Commission géologique du Canada étude 75-42 "The Gravity and Magnetic Fields of the Gulf of St. Lawrence," par R.T. Haworth et J.B. MacIntyre.





SOURCE DIAGRAM / DIAGRAMME DES SOURCES



1 Atlantic Geoscience Centre data collected during surveys by the Canadian Hydrographic Service. The 1:250,000 Natural Resource Series maps have also been produced from these data.

2 Goodacre A.K., Brule B.G. and Cooper R.V. (1969). Results of regional underwater gravity surveys in the Gulf of St. Lawrence. Dominion Observatory Gravity Map Series, Number 86.

3 Stephens L.E. and Cooper R.V. (1973). Results of underwater gravity surveys over the southern Nova Scotia continental shelf. Earth Physics Branch Gravity Map Series, Number 149.

4 Atlantic Geoscience Centre and Earth Physics Branch data averaged over 25 km grid.

5 Weaver D.F. (1968). Preliminary results of the gravity survey of the Island of Newfoundland. Dominion Observatory Gravity Map Series, Numbers 53-57.

6 Thomas M.D. (1974). The correlation of gravity and geology in Southeastern Quebec and Southern Labrador. Earth Physics Gravity Map Series, Numbers 64-67, 96-98.

7 Earth Physics Branch Gravity Map 22.

8 Earth Physics Branch Gravity Map 78.

9 Thompson L.G.C. and Garland G.D. (1957). Gravity measurements in Quebec, south of latitude 52°N. Publications of the Dominion Observatory Vol. 19, No. 4.

10 Kane M.F., Simmons G., Diment W.H., Fitzpatrick M.M., Jayner W.B. and Bromery R.W. (1972). Bouguer gravity and generalized geologic map of New England and adjoining areas. U.S. Geological Survey Geophysical Investigations Map GP-839.

1 Les données du Centre géoscientifique de l'Atlantique ont été recueillies au cours de levés effectués par le Service hydrographique du Canada. La série des cartes au 1:250,000 des Ressources naturelles a été également établie d'après ces données.

2 Goodacre A.K., Brulé B.G. et Cooper R.V. (1969). Results of regional underwater gravity surveys in the Gulf of St Lawrence. Carte gravimétrique no. 86 de l'Observatoire fédéral.

3 Stephens L.E. et Cooper R.V. (1973). Results of underwater gravity surveys over the southern Nova Scotia continental shelf. Carte gravimétrique no. 419 de la Direction de la physique du Globe.

4 Moyenne des données du Centre géoscientifique de l'Atlantique et de la Direction de la physique du Globe sur un quadrillage de 25 km.

5 Weaver D.F. (1968). Preliminary results of the gravity survey of the Island of Newfoundland. Cartes gravimétriques nos. 53-57 de l'Observatoire fédéral.

6 Thomas M.D. (1974). The correlation of gravity and geology in Southeastern Québec and Southern Labrador. Cartes gravimétriques nos. 64-67 et 96-98 de la Direction de la physique du Globe.

7 Carte gravimétrique no. 22 de la Direction de la physique du Globe.

8 Carte gravimétrique no. 78 de la Direction de la physique du Globe.

9 Thompson L.G.C. et Garland G.D. (1957). Gravity measurements in Québec, south of latitude 52° N. Publications de l'Observatoire fédéral (vol. 19, no. 4).

10 Kane M.F., Simmons G., Diment W.H., Fitzpatrick M.M., Jayner W.B. et Bromery R.W. (1972). Bouguer gravity and generalized geologic map of New England and adjoining areas. U.S. Geological Survey Geophysical Investigations Map GP-839.

PUBLISHED BY
THE CANADIAN HYDROGRAPHIC SERVICE
DEPARTMENT OF THE ENVIRONMENT, OTTAWA

Printed by Surveys and Mapping Branch,
Department of Energy, Mines and Resources

PUBLIÉE PAR
LE SERVICE HYDROGRAPHIQUE DU CANADA
MINISTÈRE DE L'ENVIRONNEMENT, OTTAWA

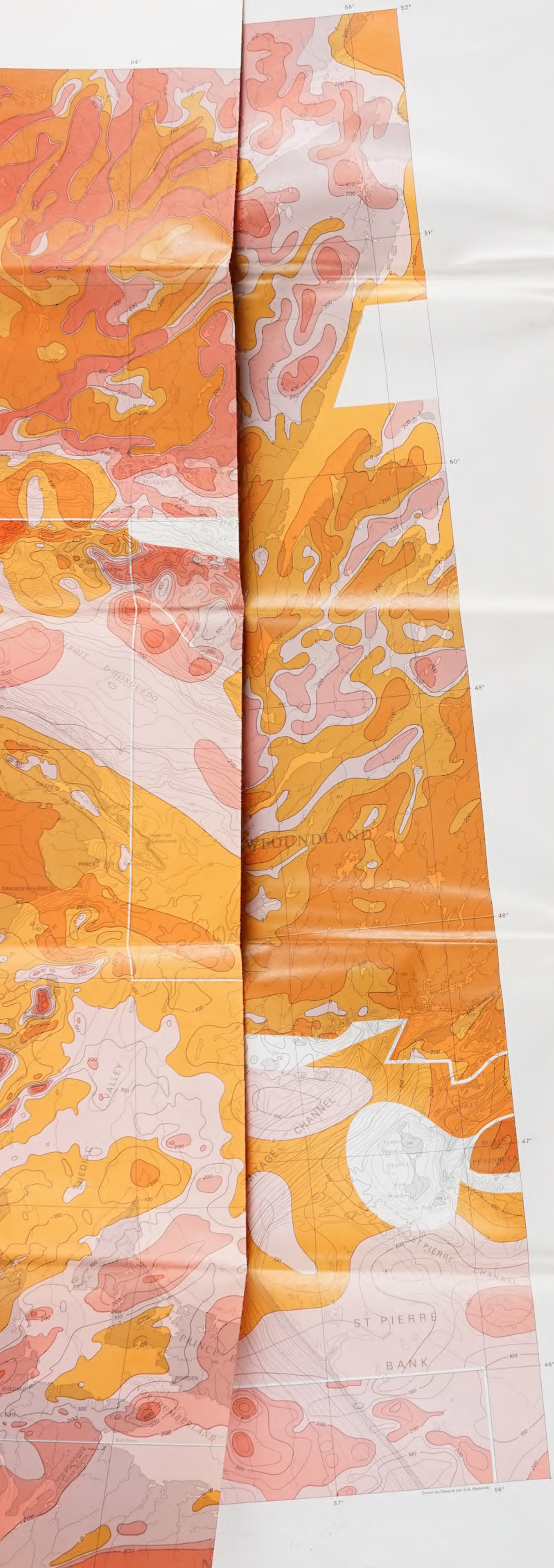
Imprimée par la Direction des levés et de la cartographie,
ministère de l'Énergie, des Mines et des Ressources

GRAVITY (BOUGUER ANOMALY) 811-D GRAVITÉ (ANOMALIE DE BOUGUER)
FIRST EDITION 1975
FIRST BATHYMETRY EDITION 1973
PREMIÈRE ÉDITION 1975
PREMIÈRE ÉDITION BATHYMÉTRIQUE 1973

811-E


MAINE
NEW
BRUNSWICK
NOVA SCOTIA
PRINCE EDWARD ISLAND
CAPE BRETON
ISLAND
NEWFOUNDLAND
ST PIERRE
BANK
HERMITAGE CHANNEL
PENINSULE DE GASPE
LES NOTRE-DAME

811-E



GULF OF ST. LAWRENCE / GOLFE SAINT-LAURENT

MAGNETIC ANOMALY / ANOMALIE MAGNÉTIQUE

Compiled by R.T. Haworth, Atlantic Geoscience Centre
Cartography by the Canadian Hydrographic Service

Compilé par R.T. Haworth, Centre géoscientifique de l'Atlantique
Cartographie du Service hydrographique du Canada

MAGNETIC CONTOURS IN GAMMA
(Referred to the International Geomagnetic Reference Field)

COURBES MAGNÉTIQUES EN GAMMA
(Anomalies magnétiques rapportées au "Système géomagnétique de référence international")

BATHYMETRIC CONTOURS IN METRES

COURBES BATHYMÉTRIQUES EN MÈTRES

Lambert Conformal Projection (Standard Parallels 43N and 49N)

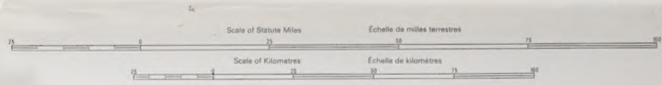
Scale 1:1 000 000

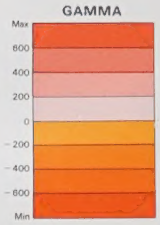
Projection conforme de Lambert (Parallèles standard 43N et 49N)

Échelle 1:1 000 000

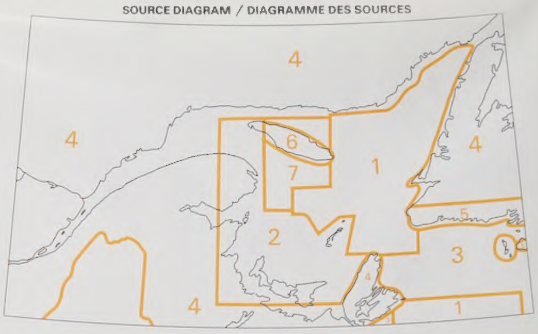
This map accompanies Marine Science Paper 16 / Geological Survey of Canada Paper 75-42, "The Gravity and Magnetic Fields of the Gulf of St. Lawrence", by R.T. Haworth and J.B. MacIntyre.

Cette carte est comprise dans l'étude 15 des Sciences de la Mer / Commission géologique du Canada étude 75-42 "The Gravity and Magnetic Fields of the Gulf of St. Lawrence," par R.T. Haworth et J.B. MacIntyre.





SOURCE DIAGRAM / DIAGRAMME DES SOURCES



1 Atlantic Geoscience Centre data collected during surveys by the Canadian Hydrographic Service. The 1:250,000 Natural Resource Series maps have also been produced from these data.

2 Hood P., McGrath P.H. and Haworth R.T. (1974). Magnetic anomaly map of the Atlantic Provinces (unpublished).

3 Atlantic Geoscience Centre data averaged over 25 km grid.

4 Carte des anomalies magnétique du Canada (1971). Geological Survey of Canada Map 1255A (2nd edition). (Data have been increased by 200 gamma to coincide with I.G.R.F. referenced data)

5 Simplified from source 2 for compatibility with source 4.

6 Imperial Oil Enterprises Ltd. data. *see*: Roliff W.A. (1968) Oil and gas exploration - Anticosti Island, Québec; Geological Association of Canada Proceedings Vol. 19, Pages 31-36.

7 Atlantic Geoscience Centre data; on widely spaced tracks, hand contoured to provide continuity with contiguous areas.

1 Les données du Centre géoscientifique de l'Atlantique ont été recueillies au cours de levés effectués par le Service hydrographique du Canada. La série des cartes au 1:250,000 des Ressources naturelles a été également établie d'après ces données.

2 Hood P., McGrath P.H. et Haworth R.T. (1974). Magnetic anomaly map of the Atlantic provinces (carte non publiée).

3 Moyenne des données du Centre géoscientifique de l'Atlantique sur un quadrillage de 25 km.

4 Carte des anomalies magnétique du Canada (1971). Carte no 1255A (deuxième édition) de la Commission géologique du Canada. (200 gamma ont été ajoutés aux données afin de faire coïncider ces dernières avec celles qui sont rapportées au Système géomagnétique de référence international)

5 Les données sus mentionnées au no. 2 ont été simplifiées afin de les rendre compatibles avec celles qui sont indiquées au no. 4.

6 Les données du Imperial Oil Enterprises Ltd. *voir*: Roliff W.A. (1968). Oil and gas exploration Anticosti Island, Québec; Geological Association of Canada, Proceedings Vol. 19, Pages 31-36.

7 Les données, du Centre géoscientifique de l'Atlantique sont basées sur des trajets de navire espacés. Les courbes magnétiques ont été dressées à la main pour assurer une continuité aux régions contiguës.

PUBLISHED BY
THE CANADIAN HYDROGRAPHIC SERVICE
DEPARTMENT OF THE ENVIRONMENT, OTTAWA

Printed by Surveys and Mapping Branch,
Department of Energy, Mines and Resources

PUBLIÉE PAR
LE SERVICE HYDROGRAPHIQUE DU CANADA
MINISTÈRE DE L'ENVIRONNEMENT, OTTAWA

Imprimée par la Direction des levés et de la cartographie,
ministère de l'Énergie, des Mines et des Ressources

MAGNETIC (ANOMALY)
FIRST EDITION 1975
FIRST BATHYMETRY EDITION 1973

811-E

MAGNÉTIQUE (ANOMALIE)
PREMIÈRE ÉDITION 1975
PREMIÈRE ÉDITION BATHYMÉTRIQUE 1973